IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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First Named Inventor	: Steffen BEYER		
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Examiner	: M. L. Dixon		
Docket No.	: 010739.51198D1		
Customer No.	: 23911		
Title	: Combustion Chamber with Internal Jacket Made of a Ceramic Composite Material and Process Manufacture		

SECOND SUBMITTAL OF APPEAL BRIEF

Mail Stop Appeal Brief- Patents **March 13, 2007**
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Pursuant to the Notification of Non-Compliant Appeal Brief Applicants submit herewith their second appeal brief.

I. REAL PARTY IN INTEREST

This application has been assigned by the inventors to Astrium GmbH, a German corporation. Accordingly, the real parties in interest to the present appeal are the named inventors and Astrium GmbH.

II. RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences known to Appellants, to Appellants' legal counsel, or to the assignee which will directly affect or be directed affected by or having a bearing on the Board's decision in this appeal.

III. STATUS OF CLAIMS

Claims 11, 13-19 and 23-30 are currently pending in this application, all of which have been rejected based on prior art grounds. In particular, Claims 11, 13, 14, 21 and 24 have been rejected under 35 U.S.C. § 103(a) as unpatentable over Strasser et al (U.S. Patent No. 6,134,881) in view of Haidn et al (U.S. Patent No. 6,151,887), while Claims 17-19, 23 and 25-29 have been rejected as unpatentable over Strasser et al in view of Tuffias et al (U.S. Patent No. 5,855,828). Claims 15 and 16, which remain pending in this application do not appear to have been included in either of the foregoing prior art rejections. Nevertheless, Claims 15 and 16 are mentioned, along with Claim 19, in the discussion at the top of page 4 of the final Office Action. Accordingly, for the purpose of this appeal, Appellants have treated Claims 15 and 16 as having been rejected as unpatentable over Strasser et al in view Tuffias et al.

Accordingly, for the purposed of this Appeal, the status of the claims is as follows:

Claims 1-10 (canceled)

Claim 11 Rejected

Claim 12 Cancelled

Claim 13-19 Rejected (see comments above re claim 15 and 10)

Claims 20-22 Cancelled

Claims 23-30 Rejected

By this appeal, Appellants seek review of the rejection of Claims 11, 13-19 and 23-30, as set forth in the Office Action dated June 30, 2006.

IV. STATUS OF AMENDMENTS

Two amendments have been submitted in respect of this application, dated July 11, 2005 and February 7, 2006, respectively. Both such amendments have been entered. In addition, Appellants submitted a response dated September 29, 2006, which accompanied the Notice of Appeal submitted the same date, but did not amend the application.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

The present invention is directed to a method of manufacturing a combustion chamber for a rocket drive which includes at least one jacket made of a composite material with a ceramic matrix, in which the composite material contains a fibrous structure made of carbon containing fibers. (See paragraph

[0002], lines 1-4.) According to a feature of the invention as recited in independent claims 11 and 23, the fibrous structure includes layers of fibers forming a three-dimensional matrix. (See paragraph [0007], lines 10-11.) In particular, the fibrous structure includes three layers 1a, 1b, 1c, with the fibers of the first layers extending in a first direction in space, the fibers of the second layers extending in a second direction in space, and the fibers of the third layers extending in a third direction in space with the individual layers penetrating each other at least partially, as shown for example in Figure 1b, and as discussed in paragraph [0008], lines 1-5; paragraph [0027], lines 5-9 and paragraph [0028], lines 1-3).

In order to achieve such a structure, during formation of the fibrous structure, the fibers or bundles of fibers of each layer are separated from each other (paragraph [0008], lines 8-10; (paragraph [0027], lines 11-14), so that fibers or bundles of fibers of another layer, extending in another direction in space, can be disposed in the resulting spaces. (See Figures 1a and 1b, and paragraphs [0027] and [0028].) This feature permits mutual interpenetration of the individual layers as mentioned previously. (See paragraph [0008], lines 8-11.)

Accordingly, independent claim 11 defines a process for manufacturing a combustion chamber for a rocket drive which includes the following steps:

1. Producing a fiber structure . . . (see paragraph [0007], lines 7-8); (paragraph [0014], lines 6-7.)

2. Producing a ceramic matrix composite material a fedding cyclicant. . . . (see paragraph [0002], lines 8-9; paragraph [0014], lines 3-7.)

3. Making at least one composite material jacket . . . (see paragraph [0007], lines 2-3; paragraph [0014], lines 2-6.)

4. The producing step comprises forming first, second and third layers of fibers . . . . (See paragraph [0008], lines 1-11; paragraph [0027], lines 5-9; paragraph [0028], lines 1-13.)

5. The forming of the first, second and third layers including separating the fibers or bundles of fibers of the respective layers from each other . . . (see paragraph [0008], lines 8-11; paragraph [0027], lines 11-14).

According to another feature of the invention, as recited in Claims 23-26, the process for manufacturing the combustion chamber includes the formation of a first jacket made of a ceramic matrix composite material in the manner defined in claim 11, and affixing a load-bearing external jacket thereon. (Paragraph [0018], lines 1-2). Claim 23, in particular, recites the step of providing an intermediate layer 7a between the external jacket 8a and the composite material jacket 4a, using a material that has a thermal expansion coefficient which is between the thermal expansion coefficients of the inner and outer jackets. (See paragraphs [0013], lines 1-10, paragraph [0019], lines 4-13 and paragraph [0031], lines 1-8.) As further provided in Claim 24, the external jacket comprises a metal material, and the intermediate layer comprises a composite material

with a metal matrix. Claim 30 further specifies that the step of providing the intermediate layer includes forming the metal matrix of an intermediate layer using the same metal material contained in the external jacket. (See paragraph [0013].)

Finally, independent Claim 27 defines a process for manufacturing an intermediate layer 7a between an internal jacket 4a and an external jacket 8a of a combustion chamber for a rocket drive, which process includes the steps of affixing the fibrous structure made of carbon-containing fibers on the internal jacket and depositing a metal material on a fibrous structure with simultaneous infiltration of the metal into the fibrous structure, such that at least one part of the internal jacket or the external jacket is made of a composite material with fibrous structure of carbon-containing fibers. (See paragraph [0019], lines 8-19.) Claim 29 further specifies that the depositing step in Claim 27 includes forming the external jacket itself substantially simultaneously with the infiltration of the fibrous structure with the metal material.

VI. GROUNDS OF REJECTION

1. Claims 11-14, 21 and 24 have been rejected under 35 U.S.C. § 103(a) as unpatentable over Strasser et al (U.S. Patent No. 6,134,881) in view Haidn et al (U.S. Patent No. 6,151,887); and

2. Claims 17-20, 22, 23 and 25-29 have been rejected under 35 U.S.C. § 103(a) as unpatentable over Strasser et al in view of Tuffias et al (U.S. Patent

No. 5,855,828). (While the June 30, 2006 Office Action does not expressly so state, for the purpose of this proceeding, Appellants have assumed that it was the Examiner's intention to include Claims 15 and 16 in this ground of rejection as well.)

VII. ARGUMENT

The Strasser et al reference is directed to a heat resistant, thermally insulated ductile port liner for the head of an internal combustion engine, having a tube-shaped structure formed from at least one layer of fiber reinforced ceramic matrix composite material (FRCMC). One purpose of such a port liner is to retain the residual heat of the exhaust gases in the gases themselves, by reducing the thermal flow through the port liner to the engine head and block. (See Column 1, lines 16-19; Column 2, lines 3-7; and Column 2, lines 10-12.)

However, while the port liner itself is specified as "having a three-dimensional tube-shaped structure" (Column 3, lines 26-28), as of course it must, nothing contained in Strasser et al teaches or suggests that the FRCMC material has a three-dimensional matrix structure such as described in the specification of the present application and as recited in Claim 11. In particular, Claim 11 recites that the step of producing a ceramic matrix composite material includes forming first, second and third layers of fibers or bundles of fibers, with the fibers of the first layer extending in the a first direction in space, the fibers of the second layer extending in a second direction in space and the fibers of the third layer extending in a third direction of space. In addition, as noted previously,

Claim 12 further recites that the formation of the respective layers includes separating the fibers or bundles of fibers of each respective layer, such that in each layer, fibers or bundles of fibers of another layer can be disposed in the resulting spaces. The latter feature of the invention is also neither taught nor suggested in Strasser et al.

The Haidn et al reference, on the other hand, is directed to a combustion chamber for a rocket engine, which includes inner and outer shells, the outer shell being formed from a fibrous ceramic material and the inner shell being formed from a fibrous ceramic material or from graphite. (Column 2, lines 35-39; Column 3, lines 27-29.) However, while Haidn et al mentions without elaboration that the fiber structure can be built up using three-dimensional weaving and/or braiding techniques (Column 11, lines 51-53), it fails to teach or suggest the specific structure cited in Claim 11, including the orientation of the layers recited therein or the spacing of fibers within the individual layers, as mentioned previously.

In addition, with regard to Claims 23-26, like Strasser et al, Haidn et al also fails to disclose the provision of an intermediate layer between the internal and external jackets, using a material which has a thermal expansion coefficient which is between that of the internal and external jackets, or that the external jacket is formed using a metal material and the intermediate layer is formed of a composite material with a metal matrix as recited in Claim 24, or furthermore

that the metal contained in the metal matrix is the same as that contained in the external jacket as recited in Claim 30.

Finally, Haidn et al also fails to suggest a process for manufacturing an intermediate layer between an internal jacket and an external jacket of a combustion chamber for a rocket drive as defined in Claims 27 through 29. In particular, Haidn fails to disclose depositing metal material on the fibrous structure with simultaneous infiltration of the fibrous structure with said metal material, wherein at least one part of the internal or external jacket is made of a composite material with fibrous structure of carbon-containing fibers. Moreover, Haidn et al also does not suggest that the step of depositing a metal material as recited in Claim 27 also includes formation of the external jacket substantially simultaneously with the infiltration of the fibrous structure with the metal material.

Finally, the Tuffias et al patent discloses a refractory composite structure which has a roughened surface that is dendritic in form and produced by chemical vapor deposition techniques. (See Abstract.) In particular, Tuffias et al provides a composite structure 18 which includes a noble metal layer 20 and a refractory metal layer 22 which are bonded metallurgically through an interface 24. The interface 24, in turn, is formed by a gradual transition from one metal, to a mixture of the metals, to the other metal, without discontinuities, as indicated at Column 9, lines 48-51. In contrast to the process defined in Claims 23 through 26, however, Tuffias et al does not suggest the provision of an

intermediate layer between internal and external jackets, wherein the thermal expansion coefficient of the intermediate layer is between that of the external and internal jackets. In fact, on the contrary, Tuffias et al teaches the opposite, in that a separate load-bearing layer 26 is specified as having a linear coefficient of thermal expansion which is less than "that of the bi-metal layers 20, 22 and 24". The latter language strongly suggests that the coefficients of thermal expansion of the three layers 20, 22 and 24 are the same. More importantly, however, Tuffias et al contains no disclosure that teaches the use of an intermediate layer having an expansion coefficient such as recited in Claim 23.

Moreover, Tuffias et al also fails to disclose a method, such as defined in Claims 27 through 29, in which an external jacket is formed on an internal jacket in a single step by depositing a metal layer on the carbon-containing fibrous structure of the internal jacket. Rather, in Tuffias et al, the carbon-containing composite is formed by first preparing a pre-form or construct of carbon fibers, which is subsequently infiltrated by a carbon matrix precursor, such as for example a resin, as described at Column 7, line 66 through Column 8, line 6. Moreover, none of the layers, 32, 20, 24, 22, 28, 30 of Tuffias et al is made of a composite material with fibrous structure of carbon-containing fibers. (See, for example, Column 5, line 38 through Column 10, line 3.) Claim 27, however, requires that at least one part of the internal jacket or the external jacket is made of composite material with fibrous structure of carbon-containing fibers.

In Tuffias et al, an optional oxidation resistant coating (30) may be applied to the exterior of the load-bearing layer (26) if desired. (See Column 9, lines 57-61.) It is apparent that the coating (30) is applied after the production process, and is not an integral part of it. Claim 27 on the other hand, recites a step of depositing a metal material, where the depositing step includes formation of the external jacket, substantially simultaneously with infiltration of the fibrous structure with the metal material. Insofar as the disclosure in Tuffias et al indicates, however, the coating 30 does not appear to be formed substantially simultaneously with the infiltration of the load-bearing layer (26).

With regard to the rejection of Claims 11-14, 21 and 24 over Strasser et al and Haidn et al, Appellants respectfully submit that at least the following steps which are recited in Claim 11 are neither taught nor suggested by either reference:

> "said producing step comprises forming first, second and third layers of fibers or bundles of fibers, wherein fibers of said first layer extend in a first direction in space; fibers of said second layer extend in a second direction in space; and fibers of said third layer extend in a third direction in space; and wherein said first, second, and third layers penetrate each other at least partially; and
>
> said forming of first, second and third layers includes separating said fibers or bundles of fibers of the respective layers

> from each other such that in each layer, fibers or bundles of fibers of another layer can be disposed in resulting spaces".

In particular, while Strasser et al discloses a port liner having a three dimensional tube shaped structure (Column 3, lines 26-28), it contains no disclosure which suggests that either of the inner or outer walls, which are formed of a fiber reinforced ceramic matrix composite material, has a structure comprising first, second and third layers of bundles of fibers extending in first, second and third directions in space, respectively, and penetrating each other at least partially, as recited in the claims. Furthermore, the fabrication process in Strasser et al, which is described at Column 9, line 8 through Column 12, line 54, does not include a step of forming such first, second and third layers (as described) by separating the fibers or bundles of fibers of the respective layers from each other, such that in each layer, the fibers or bundles of fibers of another layer can be disposed in the resulting spaces.

Appellants acknowledge that, as noted in item 6 of the Office Action, the Patent Office frequently takes the position that structural limitations in process claims are not limiting, and need not be taken into account. Nevertheless, in this instance, Appellants respectfully submit that in the context of Claim 11, the step of producing a ceramic matrix composite by forming first, second and third layers in the spatial relationships described, does in fact constitute a valid limitation of the step of "forming". That is, any step of "forming" is necessarily limited by the specification of that which the step forms. A step of "forming" a

sphere, for example, differs from a step of "forming" a rod. Otherwise, a step of "forming" would have no meaning.

Moreover, the last paragraph of Claim 11 recites a step of "separating said fibers or bundles of fibers of the respective layers from each other". The latter step is also clearly limiting, and cannot be ignored. Neither of these limitations is taught or suggested in the Strasser et al patent.

The Haidn et al patent, on the other hand, is directed to a combustion chamber for a rocket engine, which includes inner and outer shells, the outer shell being formed of a fibrous ceramic material and the inner shell being formed of a fibrous ceramic material or from graphite. (See Column 2, lines 35-39, Column 3, lines 27-29.) While Haidn et al states at Column 11, lines 51 to 53, that the fibrous structure can be built up using three-dimensional weaving and/or braiding techniques, nowhere does it teach or suggest the specific process steps defined in the last two paragraphs of Claim 11, as described above. In fact, Haidn et al contains no explanation at all regarding the particular steps by which the fibrous structure is formed.

Claim 24 has also been rejected as unpatentable over Strasser et al in view of Haidn et al. However, Appellants note that Claim 24 depends from Claim 23, which recites a step of providing an intermediate layer between the external jacket and the composite material jacket which intermediate layer has a thermal expansion coefficient which is between that of the external jacket and

that of the composite material jacket. Insofar as Appellants have been able to determine, that feature of the invention is neither taught nor suggested by either of Haidn et al or Strasser et al. Accordingly, Appellants respectfully submit that Claim 24 distinguishes over both references.

With regard to the rejection of Claims 17-20, 22, 23 and 25-29 as unpatentable over Strasser et al in view of Tuffias et al, Appellants note that Claims 17 through 19 depend from Claim 11, and are therefore allowable for the reasons articulated previously. (Claims 20 and 22 have been cancelled.) However, to the extent that these claims have been rejected over Strasser et al in view of Tuffias et al, Appellants respectfully submit that they distinguish for the further reasons set forth hereinbelow.

Tuffias et al discloses a refractory composite structure which has a roughened dendritic surface, and is produced by chemical vapor deposition, as noted in the Abstract. In particular, Tuffias et al provides a composite structure 18 which includes a noble metal layer 20 and a refractory metal layer 22 that are bonded metallurgically through an interface 24. The interface 24 in turn is formed by a gradual transition from one metal to a mixture of the metals to the other metal, without discontinuities, as indicated at Column 9, lines 48-51.

Claims 17 through 19 of the present application are directed to an embodiment of the invention which further comprises channel-shaped spaces formed on or in the fibrous structure. Claim 17 recites that a metal coating is

applied to the surface areas of the composite material that have the channel-shaped spaces. (Claim 18 is similar, but depends from Claim 16, rather than Claim 15.) Finally, Claim 9 further recites a step of arranging channel-shaped contracting bodies on or in the fibrous structure. The latter features of the invention are neither taught nor suggested in either Strasser et al or Tuffias et al.

Furthermore, Claim 23 is directed to an embodiment of the invention, referred to previously, which includes the step of providing an intermediate layer between the external jacket and the composite material jacket, which intermediate layer has a thermal co-expansion coefficient that is between that of the external jacket and that of the composite material jacket. The latter feature of the invention is also neither taught nor suggested in either of Strasser et al or Tuffias et al. It is noteworthy in this regard that the intermediate layer 28 in Strasser et al is disclosed as potentially comprising materials such as "ceramic powder, ceramic foam, dry fibers, diatomaceous earth, or other high-temperature capable insulating materials". (Column 6, lines 24-26.) The essential feature of such materials is that they are good thermal insulators. The Strasser et al reference contains no discussion at all regarding the coefficient of thermal expansion of any such materials as might be used for the intermediate layer. Tuffias et al, on the other hand, contains no such intermediate layer. Since Claims 25 depends on Claim 23, while Claim 26 depends on Claim 24, which in

turn depends on Claim 23, Claims 25 and 26 distinguish over the cited references for the reason reasons.

Claims 27-29 define a process for manufacturing an intermediate layer between and internal jacket and an external jacket of a combustion chamber for a rocket drive, including the steps of affixing a fibrous structure made of carbon containing fibers on the internal jacket and depositing a metal material on the fibrous structure, with simultaneously infiltration of the fibrous structure with the metal material. Finally, Claim 27 recites that at least one part of the internal jacket or of the external jacket is made of a composite material with fibrous structure carbon containing fibers.

In Tuffias et al, the carbon containing composite is formed by preparing a preform or construct of carbon fibers, which is subsequently infiltrated by a carbon matrix precursor, such as a resin, as described at Column 7, line 66 through Column 8, line 6. None of the layers 32, 20, 24, 22, 28 or 30 of the Tuffias et al, however, is made of a composite material with fibrous structure of carbon containing fibers. (See, for example, Column 5, line 38 through Column 10, line 3.) Claim 27 requires that at least one part of the internal jacket or external jacket be made of composite material with fibrous structure of carbon containing fibers. Accordingly, Tuffias neither teaches nor suggests the specific process defined in Claims 27 through 29.

With regard to the last two sentences of item 3 of the Office Action, Appellants acknowledge that the Tuffias et al reference at Column 6, line 12 refers to protecting the exposed side of a platinum group metallic object by applying a thin oxide ceramic or metal layer. Moreover, at Column 9, lines 61-64, referred to in the Office Action, Tuffias et al suggests applying an oxidation resistant coating to a structural composite which is to be used in an oxidizing environment.

The Office Action is not specific with respect to exactly which claims this portion of the disclosure is believed to be relevant; however, it would appear that these comments are directed towards Claims 17 and 18 which recite a step of applying a metal coating at least to surface areas of the composite material that have the channel shaped spaces.

Appellants do not claim to have invented the generic technique of applying a metal coating to the surface of a composite material. However, Appellants do respectfully submit that disclosure in Tuffias et al falls far short of teaching or suggesting the process steps in Claims 17 and 18, in which a metal coating is applied at least to the surface areas of the composite materials that have the channel shaped spaces such as recited in Claims 16/15/11. As noted in paragraph [0016], such a metallic coating provides an additional seal and load bearing reinforcement of the channel structures, which therefore better fulfill the requirements imposed on the coolant, which flows through the channels. The claims therefore define a process which goes well beyond the mere recitation in

Tuffias et al that the "exposed side" of a platinum group metal, or a structure composite item, may be coated with "an oxidation resistant coating".

VIII. CONCLUSION

For the reasons discussed in detail above, Appellants respectfully submit that Claims 11, 13-19 and 23-30 of the present application are patentable over the references of record. Accordingly, Appellants request that the Board reverse the rejection of these claims, and allow the present application.

This Appeal Brief is accompanied by the required appeal fee in the amount of $500. This amount is believed to be correct, however, the Commissioner is hereby authorized to charge any deficiency, or credit any overpayment, to Deposit Account No. 05-1323, Docket No.: 010739.51198D1.

Respectfully submitted,

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CLAIMS APPENDIX

Claim 11. A process for manufacturing a combustion chamber for a rocket drive, comprising:

producing a fibrous structure comprising layers of carbon-containing fibers which form a three-dimensional matrix;

producing a ceramic matrix composite material by feeding silicon into said fibrous structure to form a silicon carbide matrix; and

making at least one composite material jacket of said combustion chamber from said composite material; wherein,

said producing step comprises forming first, second and third layers of fibers or bundles of fibers, wherein fibers of said first layer extend in a first direction in space; fibers of said second layer extend in a second direction in space; and fibers of said third layer extend in a third direction in space; and wherein said first, second, and third layers penetrate each other at least partially; and

said forming of first, second and third layers includes separating said fibers or bundles of fibers of the respective layers from each other such that in each layer, fibers or bundles of fibers of another layer can be disposed in resulting spaces.

Claim 13. A process according to Claim 11, wherein said first, second and third layers of said fibrous structure are connected together by means of textile technology.

Claim 14. A process according to Claim 13, wherein said first, second, and third layers are connected together by a technique selected from the group consisting of weaving and sewing.

Claim 15. A process according to Claim 11, further comprising forming channel-shaped spaces in at least one of on the surface of the fibrous structure and in the fibrous structure.

Claim 16. A process according to Claim 15, wherein said channel-shaped spaces are formed in the surface of the composite material by mechanical treatment.

Claim 17. A process according to Claim 15, further comprising applying a metal coating at least to surface areas of the composite material that have said channel-shaped spaces.

Claim 18. A process according to Claim 16, further comprising applying a metal coating at least to the surface areas of the composite material that have said channel-shaped spaces.

Claim 19. A process according to Claim 11, further comprising arranging channel-shaped contracting bodies on at least one of on the surface of said fibrous structure and in said fibrous structure.

Claim 23. A process for manufacturing a combustion chamber for a rocket drive, comprising:

producing a fibrous structure comprising layers of carbon-containing fibers which form a three-dimensional matrix, said three-dimensional matrix having first, second and third layers of fibers, wherein fibers of said first layer extend in a first direction in space; fibers of said second layer extend in a second direction in space; and fibers of said third layer extend in a third direction in space;

producing a ceramic matrix composite material by feeding silicon into said fibrous structure to form a silicon carbide matrix;

making at least one composite material jacket from said ceramic matrix composite material;

affixing a load-bearing external jacket on said composite material jacket; and

providing an intermediate layer between said external jacket and said composite material jacket, wherein a thermal expansion coefficient of said

intermediate layer is between thermal expansion coefficients of said external jacket and of said composite material jacket.

Claim 24. A process according to Claim 23, wherein:

said external jacket comprises a metal material;

said intermediate layer comprises a composite material with a metal matrix;

said intermediate layer is affixed on said composite material jacket; and

said external jacket is affixed on said intermediate layer.

Claim 25. A process according to Claim 23, wherein said providing step comprises:

first affixing a fibrous structure on said composite material jacket; and

thereafter depositing a metal material on said fibrous structure with simultaneous infiltration of said fibrous structure with said metal material.

Claim 26. A process according to Claim 24, wherein said metal material is deposited by means of electroplating.

Claim 27. A process for manufacturing an intermediate layer between an internal jacket and an external jacket of a combustion chamber for a rocket drive, comprising:

affixing a fibrous structure made of carbon-containing fibers on the internal jacket; and

depositing a metal material on said fibrous structure with simultaneous infiltration of the fibrous structure with said metal material;

wherein at least one part of the internal jacket or the external jacket is made of a composite material with fibrous structure of carbon-containing fibers.

Claim 28. A process according to Claim 27, wherein said metal material is deposited by means of electroplating.

Claim 29. The process according to Claim 27, wherein

said depositing step includes formation of said external jacket, substantially simultaneously with infiltration of the fibrous structure with said metal material.

Claim 30. The process according to Claim 24, wherein said providing step comprises forming said metal matrix using the same metal material contained in said external jacket.

EVIDENCE APPENDIX

None

RELATED PROCEEDINGS APPENDIX

None.